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Supporting frame structure

The invention relates to a supporting frame structure for a motor vehicle according to the precharacterizing clause of claim 1.

DE 100 15 325 A1 discloses a vehicle body which comprises a supporting frame structure with at least one body component. The supporting frame structure of the vehicle body is composed here from a multiplicity of individual body components, for example member-type elements and junction elements connecting the member-type elements. In order to provide a lightweight vehicle body which can be fitted in a simple manner and is secure in an accident, it is proposed, inter alia, to design at least one of the body components as a thin-walled cast-steel part. This results in a considerable potential for saving weight of the order of magnitude of approx. 25% in comparison to conventional sheet-metal body components. A wall thickness and also a shaping can be modeled in an infinitely variable manner in accordance with the strength requirements. The design of the member-type elements and/or the junction elements as cast-steel part also offers the possibility of producing complex components in a single piece, thus dispensing with the outlay to join them together.

DE 196 53 509 A1 discloses a frame structure of a vehicle body comprising junction elements and connected, preprofiled support elements. In this case, at least one junction element is a closed, deformed sheet-steel component which, as a hydroforming junction element, is deformed by the application of an internal high pressure. At least one connecting piece is molded directly onto a hydroforming junction element of this

type and is prepared for connection to at least one preprofiled support element. The junction element is therefore composed here of steel and is suitable in particular for use in a space frame supporting framework of a vehicle body. In addition, the internal high pressure technique in the production of the connecting pieces on the junction elements and corresponding profile shapes of the supporting elements permits a highly precise seam connecting point for welded connections or adhesive bonding connections without machining being required for this.

DE 41 22 395 A1 discloses a connecting piece, in particular a connecting junction, for connecting rolled steel profiles in structural steel engineering, i.e. in building construction and civil engineering for erecting buildings and other structures. The connecting piece comprises at least one connecting region which has the cross-sectional profile of the rolled steel profiles and the flanges of which are offset inward in a step-shaped manner at the outer end for fitting into at least one pocket of a rolled steel profile to be connected. On the outside of at least one of its offset flanges, the connecting region has at least one projecting cam. The cams are produced with a slight excess length, so that, by abrading them to a greater or lesser extent, a precisely fitting, play-free seat can be achieved.

The present invention is concerned with the problem of specifying for a vehicle an improved supporting frame structure of the type mentioned at the beginning which, in particular, can be produced cost-effectively.

This object is achieved by the subject matter of the independent claim; advantageous refinements are the subject matter of the dependent claims.

The invention is based on the general concept, in the case of a supporting frame structure for a motor vehicle that is constructed from member-type elements and junction elements connecting the member-type elements, of designing at least one of the member-type elements as a rolled steel profile while at least one of the junction elements is designed as a cast-steel element. The invention therefore affords the advantage of producing a cost-effective steel supporting frame structure which has high rigidity and at the same time permits great flexibility with regard to the embodiments of the member-type elements or the junction elements.

Rolled steel profiles have high rigidity and stability values, are reliable and, in addition, provide the possibility of providing a supporting frame structure for a motor vehicle which, firstly, owing to small wall thicknesses, permit a light and weight-reduced construction with simultaneously high rigidity and, on the other hand, permit the use and processing of the abovementioned cost-effective rolled steel profiles.

Furthermore, it is of increasing interest for a recyclability of the motor vehicle with the supporting frame structure according to the invention to be significantly improved. Since the member-type elements and the junction elements are formed from steel, they do not have to be separated in a complicated manner from one another and sorted during the disposal of the motor vehicle, but rather can be supplied as a whole to a recycling process, for example to a scrap metal allowance in the production of steel. This firstly reduces costs for recycling the motor vehicle and secondly considerably improves an ecobalance of the motor vehicle. This is of significance in particular with regard to the increasingly more stringent environmental laws.

According to a preferred embodiment, the member-type elements and/or the junction elements are formed from high-quality steel. The use of high-quality steel permits the production of particularly small wall thicknesses, with simultaneously high strength. Moreover, a high corrosion resistance is obtained at the same time thereby, so that an aftertreatment usually required for this purpose in the case of steel can be omitted. Furthermore, high-quality steel affords the great advantage of being distinguished by good castability and therefore even very complexly shaped junction elements can be produced economically without this being associated with a greater number of rejects.

According to an advantageous development of the solution according to the invention, the member-type elements and/or the junction elements can have wall thicknesses matched to the load. This affords the advantage that, by means of a previous numerical simulation, load profiles, for example with regard to a transverse force profile and/or torque profile, can be calculated and the wall thicknesses of the member-like elements and/or of the junction elements can be matched to the calculated load profile. This means that smaller wall thicknesses are used in regions with lower loads whereas, in regions with load peaks, the wall thicknesses significantly increase. The production of different wall thicknesses can be realized in a simple and cost-effective manner by modern rolling technology.

In a further advantageous refinement of the invention, a connection of the member-type elements to the junction elements is designed as a mechanical joining connection. This affords the advantage that the supporting frame can first of all be produced with member-type elements or junction elements, which are releasable from one another, and, as a result, a

dimensional accuracy of the supporting frame structure can be checked at an early stage. In addition or as an alternative, it can furthermore be provided to design the member-like elements with the junction elements, for example as a fusion welding connection, as an adhesive connection or as a brazed connection and, as a result, to realize the advantages associated with the particular connecting techniques, such as, for example, a high torque transmission, and a simple joining technique.

Further important features and advantages of the invention emerge from the subclaims, from the drawing and from the associated description of the figure with reference to the drawing.

It goes without saying that the features mentioned above and those which have yet to be explained below can be used not only in the respectively stated combination but also in other combinations or on their own without departing from the scope of the present invention.

A preferred exemplary embodiment of the invention is illustrated in the drawing and is explained in more detail in the description below.

The single figure, Fig. 1, shows a schematic illustration of a supporting frame structure according to the invention.

According to Fig. 1, a motor vehicle 1 has a supporting frame structure 2 according to the invention. The supporting frame structure 2 is formed essentially from member-type elements 3 and junction elements 4 connecting the member-type elements 3. The junction elements 4 referred to here are those body components which, in a spatially compact form, permit a preferably

rigid connection between at least two of the member-type elements 3. The member-type elements 3 referred to are spatially extensive, predominantly elongate body components, such as, for example, an A-pillar 5 or a roof rack 6 but also two-dimensional components (not referred to specifically) which codetermine the spatial extent of the supporting frame structure 2.

In general, the supporting frame structure 2 according to Fig. 1 is designed as a framework-type space frame which is widespread in the automobile industry using other materials and other methods of production of the member-type elements 3. In general, it is also conceivable for the supporting frame structure 2 to be designed as a self-supporting body shell.

The junction elements 4 or at least one of these junction elements 4 are/is designed as a cast-steel element and thereby provides a rigid connecting point between two member-type elements 3. The junction elements 4 are adjoined by at least two further elements of the supporting frame structure 2, normally at least two member-type elements 3.

According to the invention, it is now provided to design at least one of the member-type elements 3 as a rolled steel profile. Rolled steel profiles of this type can be produced cost-effectively and, in addition, matched flexibly to the particular requirements or loads by changing a wall profile. The particular loads of the member-type elements 3 can be determined, for example, previously by means of numerical calculations, with the calculated load values being converted into wall thickness required for this and/or into profile geometries. These calculated wall thicknesses/geometries are then set on a rolling device which then correspondingly rolls the member-type elements.

In comparison to conventional sheet-metal profiles, rolled steel profiles have a significantly higher modulus of elasticity, as a result of which, with a wall thickness which is identical to the sheet-metal profiles, significantly higher strengths can be obtained or the wall thicknesses of the rolled steel profiles can be accordingly reduced. The solution according to the invention therefore firstly provides the possibility of protecting existing resources and at the same time of reducing the weight of a vehicle.

Furthermore, in comparison to conventional sheet-metal body components, rolled steel profiles provide better, i.e. stiffer, fastening possibilities for accessory parts, such as, for example, hinges.

In general, it is also conceivable for two junction elements 4 to be connected directly to each other without a member element 3 being placed in between.

In contrast to the member-type elements 3, the junction elements 4 may also have reinforcing structures, such as, for example, ribs and/or webs, which additionally increase the rigidity of the junction elements 4 and which can be realized in a simple manner by means of a corresponding casting mold. Owing to the fact that both the member-type elements 3 and the junction elements 4 are formed from steel, a recycling capability of the supporting frame structure 2 or of the motor vehicle 1 is also significantly increased. A complicated separating and expensive sorting, as is customary in the case of conventional supporting frame structures, can be dispensed with as a result. The supporting frame structure 2 according to the invention therefore meets demands in an ecological respect for protecting resources and for good recycling capability to a particularly high extent.

In order further to increase the quality of the supporting frame structure 2, the member-type elements 3 and/or the junction elements 4 can be formed from high-quality steel or high-strength steel. The use of high-quality steel permits particularly small wall thicknesses with high strength. In addition, a high corrosion resistance is obtained at the same time thereby and a particularly high claim of quality is thus realized. The cathodic dip painting which is required in the case of conventional supporting frame structures 2 for protection against corrosion can be dispensed with. This also makes a complicated and expensive and time-consuming finishing of the supporting frame structure 2 unnecessary, which, despite the high material costs of high-quality steel, can lead to a reduction in costs.

Since the loads occuring in the supporting frame structure 2 assume different values at different points of the member-type elements 3 and/or the junction elements 4, the member-type elements 3 and/or the junction elements 4 can have wall thicknesses matched to the load. The use of modern rolling technology, in particular, permits an optimum adaptation of the required wall thicknesses to the loads which occur, as a result of which the supporting frame structure 2 can be designed optimally and at the same time only has the minimum required wall thickness for the particular loads.

A connection between the member-type elements 3 and the junction elements 4 is possible via a wide variety of connecting methods, for example via a mechanical joining connection, a fusion welding connection, an adhesive connection or a brazed connection. All of the connecting methods mentioned have high durability and reliability and an optimum transmission of force.

The adhesive connection and the mechanical joining connection are cold joining methods which, in contrast, for example, to welding, do not result in any distortion of the supporting structure or loss of strength due to changes in the metallic structure. Therefore, in the case of the adhesive connection and in the case of the mechanical joining connection, no thermally induced forced stresses occur, as a result of which a particularly gentle connection is obtained.

In summary, the essential features of the invention can be characterized as follows:

The invention makes provision, on a supporting frame structure 2 for a motor vehicle 1 that is constructed from member-type elements 3 and junction elements 4 connecting the latter, to design at least one of the member-type elements 3 as a rolled steel profile while at least one of the junction elements 4 is designed as a cast-steel element. By this means, in particular, a very cost-effective production of the supporting frame structure 2 can be achieved.

The higher modulus of elasticity of the rolled steel profiles in comparison to conventional sheet-metal shaped parts also makes it possible to achieve a reduction in the wall thickness of the steel profiles, thus reducing the overall weight of the vehicle. In addition, the solution according to the invention increases the recycling capability of the motor vehicle 1, since the supporting frame structure 2 is now composed just of a single material and no longer - as previously customary - has to be separated in a complicated manner and sorted prior to disposal.

Furthermore, it is conceivable that the member-type elements 3 and/or the junction elements 4 are formed

from high-quality steel or high-strength steel. The embodiment in high-quality steel permits particularly small wall thicknesses with high strength. At the same time, a high corrosion resistance is obtained, so that an aftertreatment conventionally required for this purpose in the case of steel, for example a cathodic dip painting, can be saved.

In order to connect the member-type elements 3 and the junction elements 4 to one another in a simple and reliable manner, a wide variety of connections can be used, for example mechanical joining connections, fusion welding connections, adhesive connections or brazed connections.